In re Patent Application of
PAU ET AL.
Serial No. 09/390,554
Filed: SEPTEMBER 3, 1999
_____/

In the Claims:

    This listing of claims replaces all prior versions
and listing of claims in the application.

    Claims 1-4 (Canceled).

    5.   (Currently Amended) A method of calculating the
discrete cosine transform (DCT) of blocks of pixels of an
image for compressing image data to be stored or transmitted,
comprising the steps of:

    a) defining first subdivision blocks as range
blocks, having a fractional and scalable size $N/2^i*N/2^i$, where
i is an integer;

    b) defining second subdivision blocks of $N*N$ pixels
as domain blocks, shiftable by intervals of $N/2^i$ pixels;
[[and]]

    calculating, in parallel, the DCT of 2^i range blocks
of a domain block of $N*N$ pixels of the image.

    c) ordering the pixels in the range blocks of a
certain dimension by rearranging input pixels in 2^i vectors of
2^i components;

    d) calculating, in parallel, 2^i monodimensional DCTs
by processing the vectors defined in the step c);

    e) arranging output sequences of the monodimensional
DCTs relative to the 2^i vectors;

    f) completing the calculation in parallel of 2^i
bidimensional DCTs by processing output sequences of
monodimensional DCTs produced in step e); and

2

In re Patent Application of
PAU ET AL.
Serial No. 09/390,554
Filed: **SEPTEMBER 3, 1999**
_____/

     g) arranging output sequences of bidimensional DCTs generated in step f) in 2^i vectors of bidimensional DCT coefficients.

     6.   (Canceled)

     7.   (Currently Amended) A method according to ~~Claim 6~~ Claim 5, wherein the step of calculating 2^i monodimensional DCTs in parallel in step d) [[b)]] and the step of completing the parallel calculation of 2^i bidimensional DCTs of step f) [[d)]] are performed by subdividing the sequences resulting from step c) [[a)]] and from step e) [[c)]], respectively, in groups of scalar elements, calculating the sums and differences thereof by way of adders and subtractors and by reiterately multiplying the sum and difference results by respective coefficients until completing the calculation of the relative DCT coefficients, respectively monodimensional and bidimensional.

     8.   (Currently Amended) A method of compressing data of an image to be stored or transmitted, comprising the steps of:

     defining first subdivision blocks as range blocks, having a fractional and scalable size $N/2^i * N/2^i$, where i is an integer;

     defining second subdivision blocks of $N*N$ pixels as domain blocks, shiftable by intervals of $N/2^i$ pixels;

In re Patent Application of
PAU ET AL.
Serial No. 09/390,554
Filed: **SEPTEMBER 3, 1999**
_____/

    calculating, in parallel, the DCT of 2^i range blocks [[and]] of a relative domain block;

    classifying the transformed range blocks according to their relative complexity represented by a sum of values of three AC coefficients;

    applying a fractal transform in the DCT domain to data of the range blocks whose complexity classification exceeds a pre-defined threshold and only storing a DC coefficient of the range blocks with a complexity lower than the threshold, while identifying a relative domain block to which the range block in a transformation belongs that produces a best fractal approximation of the range block;

    calculating a difference between each range block and its fractal approximation;

    quantizing the difference in the DCT domain by using a quantization table preestablished in consideration of human sight characteristics;

    coding the quantized difference by a process based on probabilities of quantization coefficients; and

    storing or transmitting code of each range block compressed in the DCT domain and the DC coefficient of each uncompressed range block.

    9. (Currently Amended) An apparatus for calculating the discrete cosine transform (DCT) of blocks of pixels of an image _for compressing image data to be stored or transmitted_, the apparatus comprising:

4

In re Patent Application of
PAU ET AL.
Serial No. 09/390,554
Filed: SEPTEMBER 3, 1999
_____/

means for defining first subdivision blocks as range blocks, having a fractional and scalable size $N/2^i * N/2^i$, where i is an integer;

means for defining second subdivision blocks of $N*N$ pixels as domain blocks, shiftable by intervals of $N/2^i$ pixels; [[and]]

~~means for calculating, in parallel, the DCT of 2^i range blocks of a domain block of $N*N$ pixels of the image.~~

means for ordering the pixels in the range blocks of a certain dimension by rearranging input pixels in 2^i vectors of 2^i components;

means for calculating, in parallel, 2^i monodimensional DCTs by processing the vectors defined by the means for calculating;

means for arranging output sequences of the monodimensional DCTs relative to the 2^i vectors;

means for completing the calculation in parallel of 2^i bidimensional DCTs by processing output sequences of monodimensional DCTs produced by the means for arranging output sequences of the monodimensional DCTs; and

means for arranging output sequences of bidimensional DCTs, generated by the means for completing the calculation, in 2^i vectors of bidimensional DCT coefficients.

10.   (Canceled)

11.   (Currently Amended) An apparatus according to ~~Claim 10~~ Claim 9, wherein the means for calculating 2^i

5

In re Patent Application of
PAU ET AL.
Serial No. 09/390,554
Filed: **SEPTEMBER 3, 1999**
_____/

monodimensional DCTs in parallel in and the means for
completing the parallel calculation of 2^i bidimensional DCTs
are for subdividing the sequences resulting from the means for
ordering and the means for arranging output sequences of the
monodimensional DCTs, respectively, in groups of scalar
elements, calculating the sums and differences thereof by way
of adders and subtractors and by reiterately multiplying the
sum and difference results by respective coefficients until
completing the calculation of the relative DCT coefficients,
respectively monodimensional and bidimensional.

        12.   (Previously presented) An apparatus for
compressing data of an image to be stored or transmitted,
comprising:

        means for defining first subdivision blocks as range
blocks, having a fractional and scalable size $N/2^i*N/2^i$, where
i is an integer;

        means for defining second subdivision blocks of $N*N$
pixels as domain blocks, shiftable by intervals of $N/2^i$ pixels;

        means for calculating, in parallel, the DCT of 2^i
range blocks and of a relative domain block;

        means for classifying the transformed range blocks
according to their relative complexity represented by a sum of
values of three AC coefficients;

        means for applying a fractal transform in the DCT
domain to data of the range blocks whose complexity
classification exceeds a pre-defined threshold and only
storing a DC coefficient of the range blocks with a complexity

6

In re Patent Application of
PAU ET AL.
Serial No. 09/390,554
Filed: **SEPTEMBER 3, 1999**
_____/

lower than the threshold, while identifying a relative domain
block to which the range block in a transformation belongs
that produces a best fractal approximation of the range block;

means for calculating a difference between each
range block and its fractal approximation;

means for quantizing the difference in the DCT
domain by using a quantization table preestablished in
consideration of human sight characteristics;

means for coding the quantized difference by a
process based on probabilities of quantization coefficients;
and

means for storing or transmitting code of each range
block compressed in the DCT domain and the DC coefficient of
each uncompressed range block.

13.   (Currently Amended) An apparatus for
calculating the discrete cosine transform (DCT) of blocks of
pixels of an image <u>for compressing image data to be stored or
transmitted</u>, the apparatus comprising:

a first defining unit to define first subdivision
blocks as range blocks, having a fractional and scalable size
$N/2^i*N/2^i$, where i is an integer;

a second defining unit to define second subdivision
blocks of $N*N$ pixels as domain blocks, shiftable by intervals
of $N/2^i$ pixels; ~~and~~

~~a calculation unit to calculate, in parallel, the
DCT of 2^i range blocks of a domain block of N*N pixels of the
image.~~

7

In re Patent Application of
PAU ET AL.
Serial No. 09/390,554
Filed: **SEPTEMBER 3, 1999**
_____/

an ordering module to order the pixels in the range blocks of a certain dimension by rearranging input pixels in 2^i vectors of 2^i components;

a first calculating module to calculate, in parallel, 2^i monodimensional DCTs by processing vectors defined by the calculation unit;

a first output module to arrange output sequences of the monodimensional DCTs relative to the 2^i vectors;

a second calculating module to complete the calculation in parallel of 2^i bidimensional DCTs by processing output sequences of monodimensional DCTs produced by the output module; and

a second output module to arrange output sequences of bidimensional DCTs, generated by the second calculating module, in 2^i vectors of bidimensional DCT coefficients.

14.   (Canceled)

15.   (New) An apparatus for calculating the discrete cosine transform (DCT) of blocks of pixels of an image for compressing image data to be stored or transmitted, the apparatus comprising:

a first defining unit to define first subdivision blocks as range blocks, having a fractional and scalable size $N/2^i*N/2^i$, where i is an integer;

a second defining unit to define second subdivision blocks of $N*N$ pixels as domain blocks, shiftable by intervals of $N/2^i$ pixels; and

8

In re Patent Application of
PAU ET AL.
Serial No. 09/390,554
Filed: **SEPTEMBER 3, 1999**
_____/

      an array of adders, subtractors and multipliers and
a plurality of path selectors and multiplexers for configuring
the array according to a selected value of said integer i, for
calculating the DCT on either the undivided domain block of
$N*N$ pixels or, in parallel, on said range blocks of
subdivisions of the domain block.